Progress and plans of global and LAM data assimilation at Météo-France

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ALADIN/HIRLAM All Staff Meeting, 3-6 April 2017, Helsinki

ARPEGE current oper DA config

Deterministic DA cycle :

- 4D-VAR: NL trajectory at TL1198C2.2; two outer loops with minimizations using a linearized cost function around low resolution trajectories at TL149C1.0 (almost adiabatic) and TL399C1.0 (with some simplified physics)
- Change of geometries using Full-POS 927; 105 levels (10m → 0.1 hPa)
- Hybrid B matrix using variance and some correlation information from daily EDA
- Surface OI (CANARI): RH2m and T2m provide increments for Ts and Ws

Ensemble DA (AEARP) :

- 25 members at TL399C1.0, 105 levels (one 4D-VAR minimization)

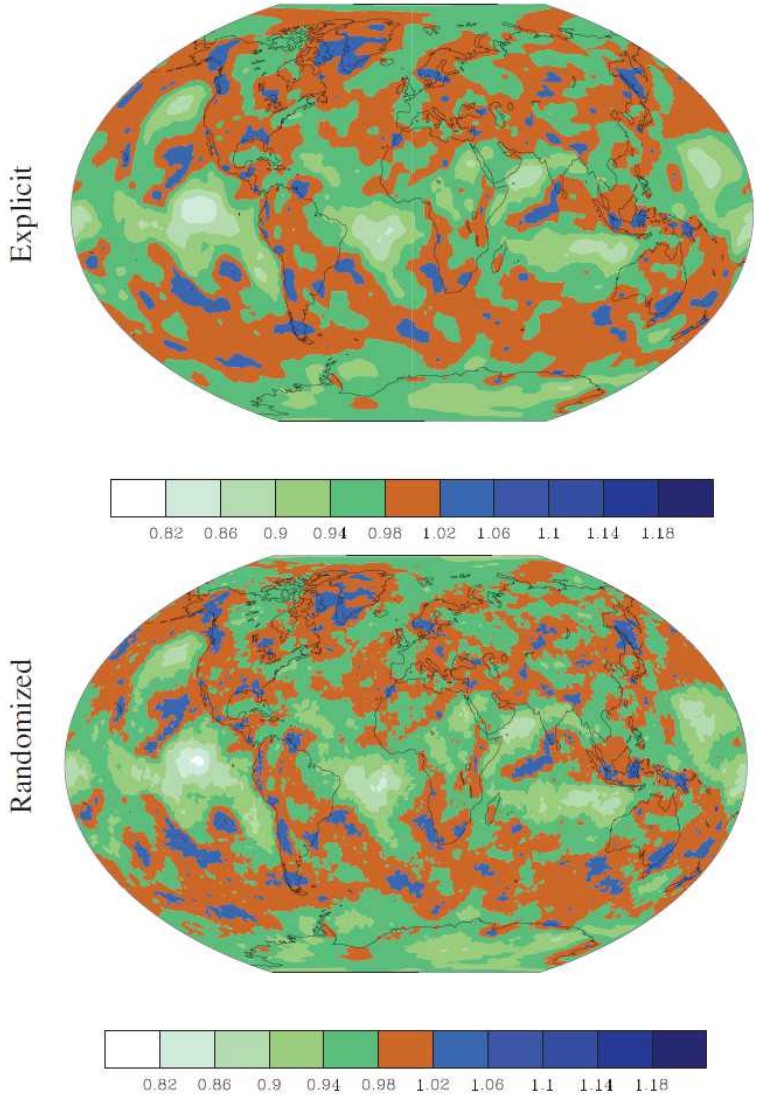
Operational CY41T1_op1 since 8 December 2015

Current e-suite CY42_op2

- **Description for Arpege / AEARP (EDA) / PEARP (EPS)**
- New convection scheme PCMT in Arpege and AEARP
- SURFEX model (surface parameterizations)
- AEARP: resolution increase for the computation of background error variances
- AEARP: normalisation of variances induced by wavelet modelling of correlations
- VarBC on ground GPS observations
- Assimilation of 2 water vapour channels (183GHz) of GMI on GPM
- Assimilation of 3 water vapour channels (183GHz) of MWHS2 on FY3-C
- Higher density of GEORAD (from 250 to 125km)
- Assimilation of window SEVIRI channels (4, 6, 7, 8 over sea)
- 5 new channels (ozone) for IASI; denser thinning (125km=>100km) adds 50%
- New physics in PEARP (ARPEGE EPS)
- Optimisations (new compiler version, etc.)
- New diagnostics (domain, variables, etc.)
- **Description for Arome**
- Refer to talk by François (model aspects)
- Note: Incremental Analysis Update utilized in Arome-Overseas

Operational switch foreseen in May 2017

Normalisation of a wavelet-based correlation matrix $\mathbf{C} = \mathbf{W}^{-1}\mathbf{D}\mathbf{W}^{-T}$



Normalisation coefficients 1/**σ**
(which can be included in the correlation model)

Diagnosis of diagonal values **σ²** of **C** :

Explicit formula :
(accurate, at low cost)

$$\sigma^2 = \widetilde{\mathbf{W}}^{-1}\mathbf{d}$$

i.e. apply a modified inverse wavelet transform $\widetilde{\mathbf{W}}^{-1}$
(using squared values of wavelet filters in **W**)
to variance fields **d** of wavelet coefficients.

Randomization approach *(with N=10,000 vectors)**:***
(less accurate and more costly)

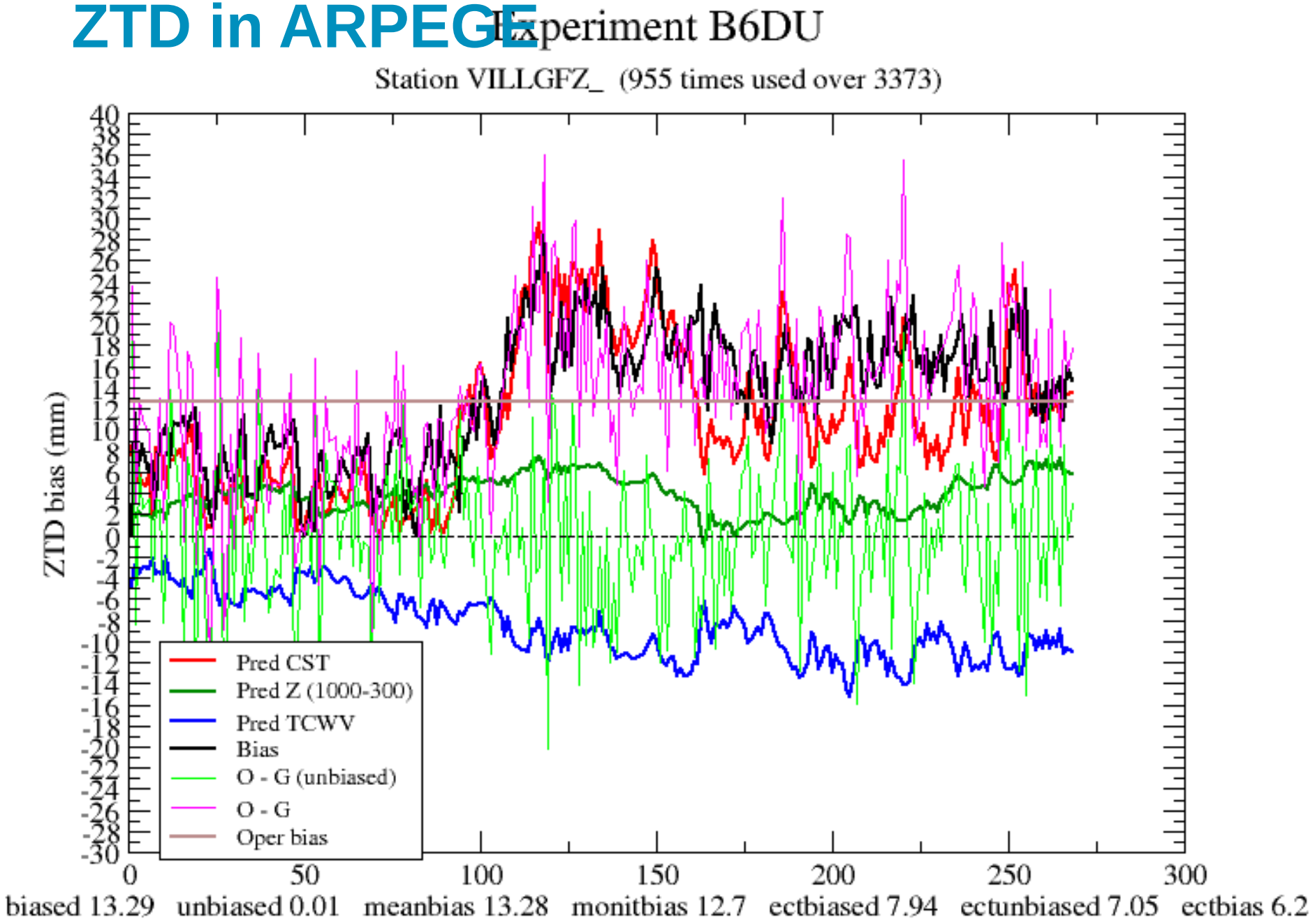
$$\sigma^2 = \mathbf{var}\left(\mathbf{W}^{-1}\mathbf{D}^{1/2}\eta\right)$$

(Chabot, Berre and Desroziers 2017, QJRMS)

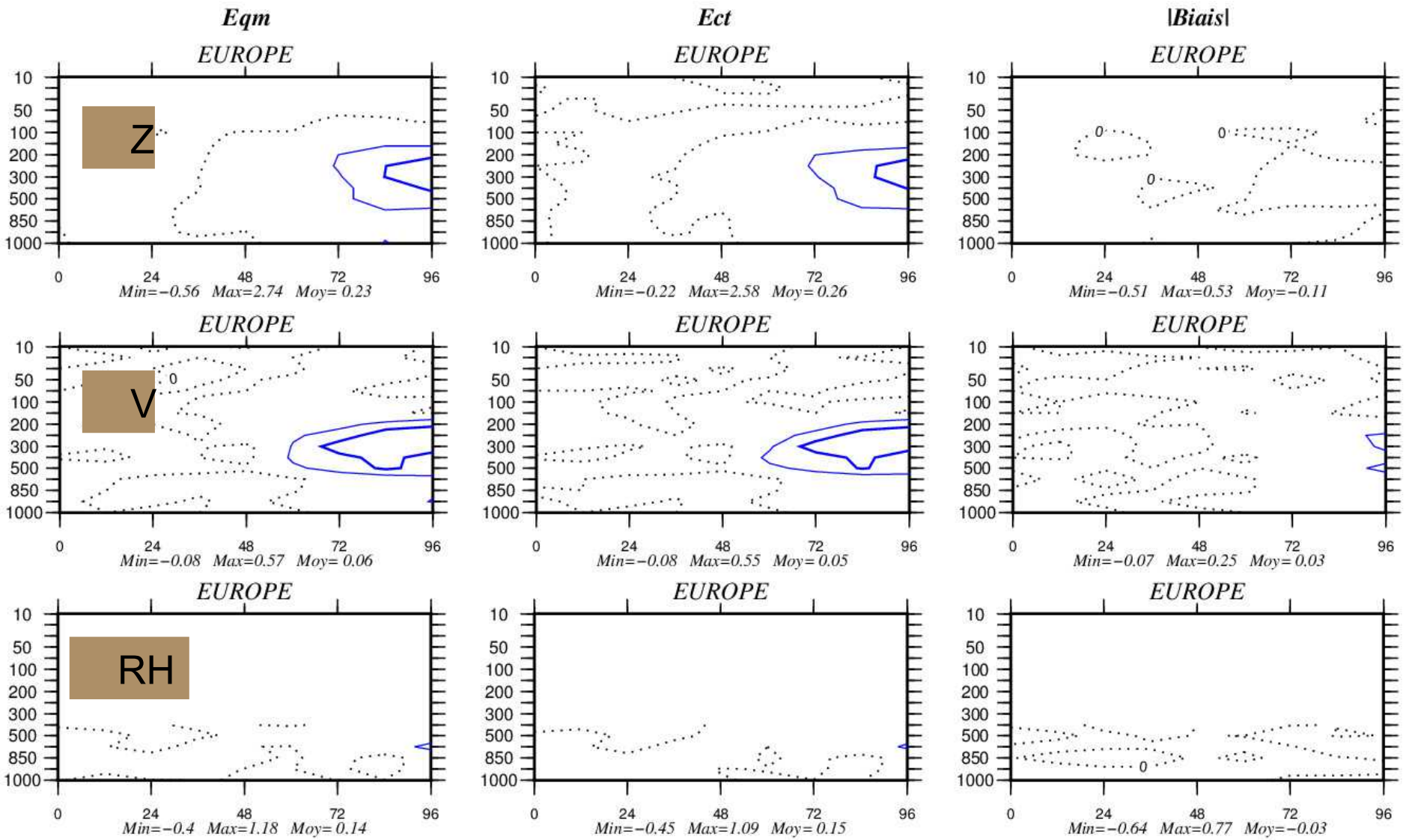
Activities in progress or planned for GPS delay data

- Use of VarBC (Cst; TWCV; ΔZ[1000-300hPa]) in the current e-suite for ARPEGE and AROME (to become operational by Spring 2017)
- Development of an observation operator in order to assimilate ZTD gradients in AROME (collaboration with Météo-Maroc)
- Issues : how to get again access to data from NOAA network ?
- Longer term activities : assimilation of STD in AROME (through collaborations with KNMI)

Variational bias correction for GPS ZTD in ARPEGE



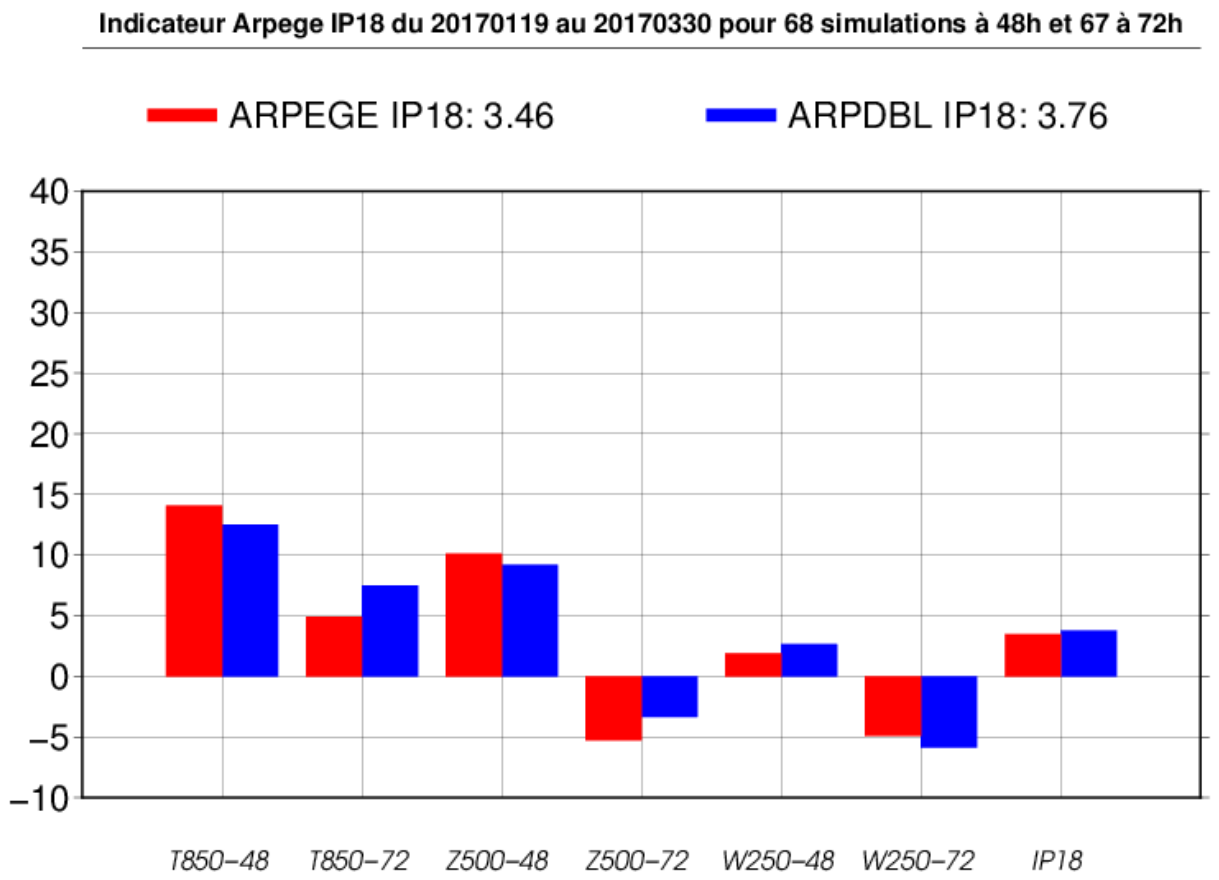
VarBC of GPS ZTD in ARPEGE



Forecast scores : Static BC – Var BC ☺ ☹

ARPEGE e-suite evaluation in progress; ARPEGE indicator (« IP18 »)

- Mixed scores w/r to RS, rather positive scores w/r to ECMWF analysis
- Slightly improved representation of precipitation (extension, daily cycle)
- Improved diagnostics of wind gusts
- Changes in forecast behaviour of T2m, RH2m and V10m
- Both objective and subjective evaluation is ongoing

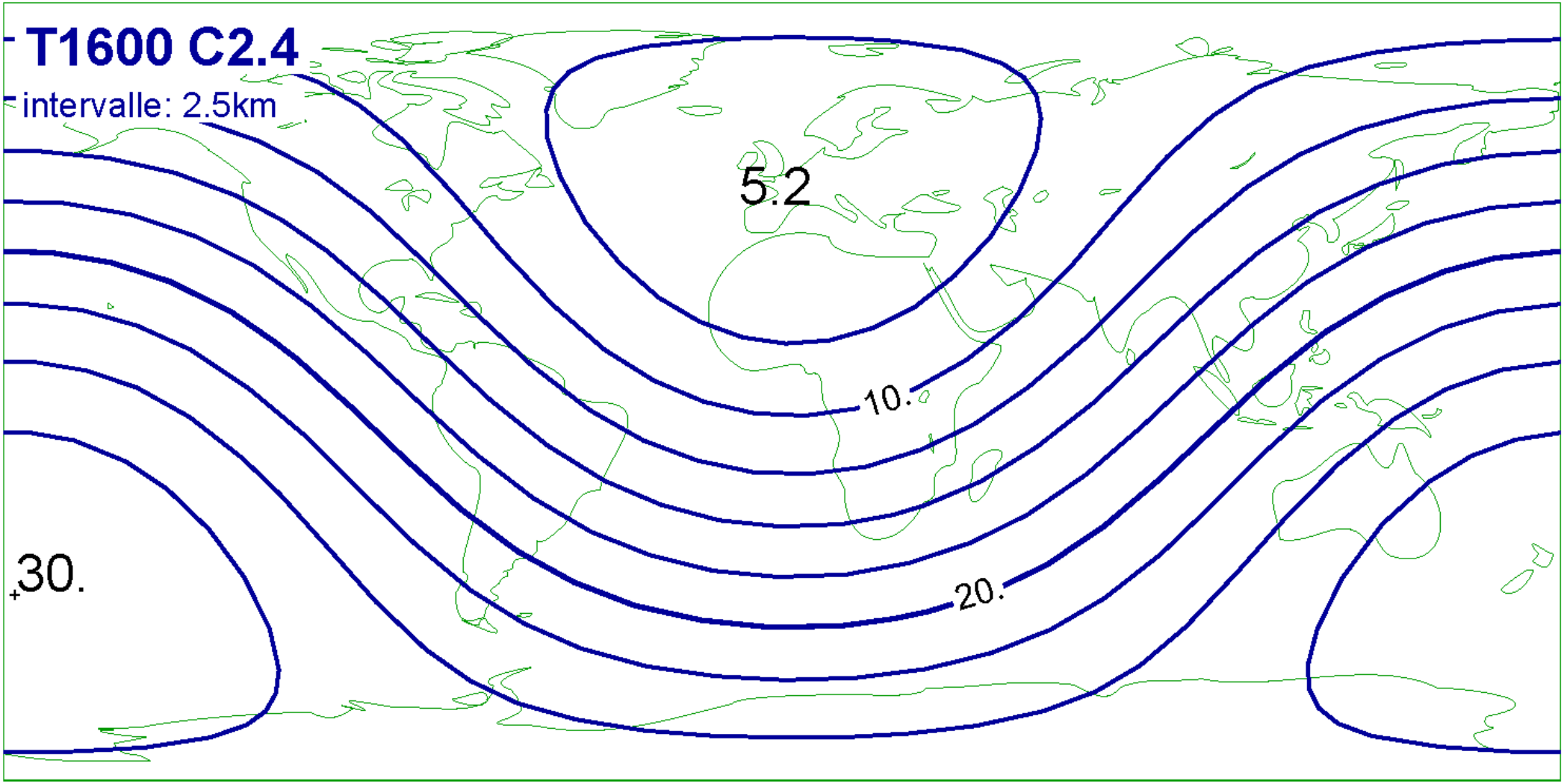


Next e-suite: CY43T2 or CY44 (?)

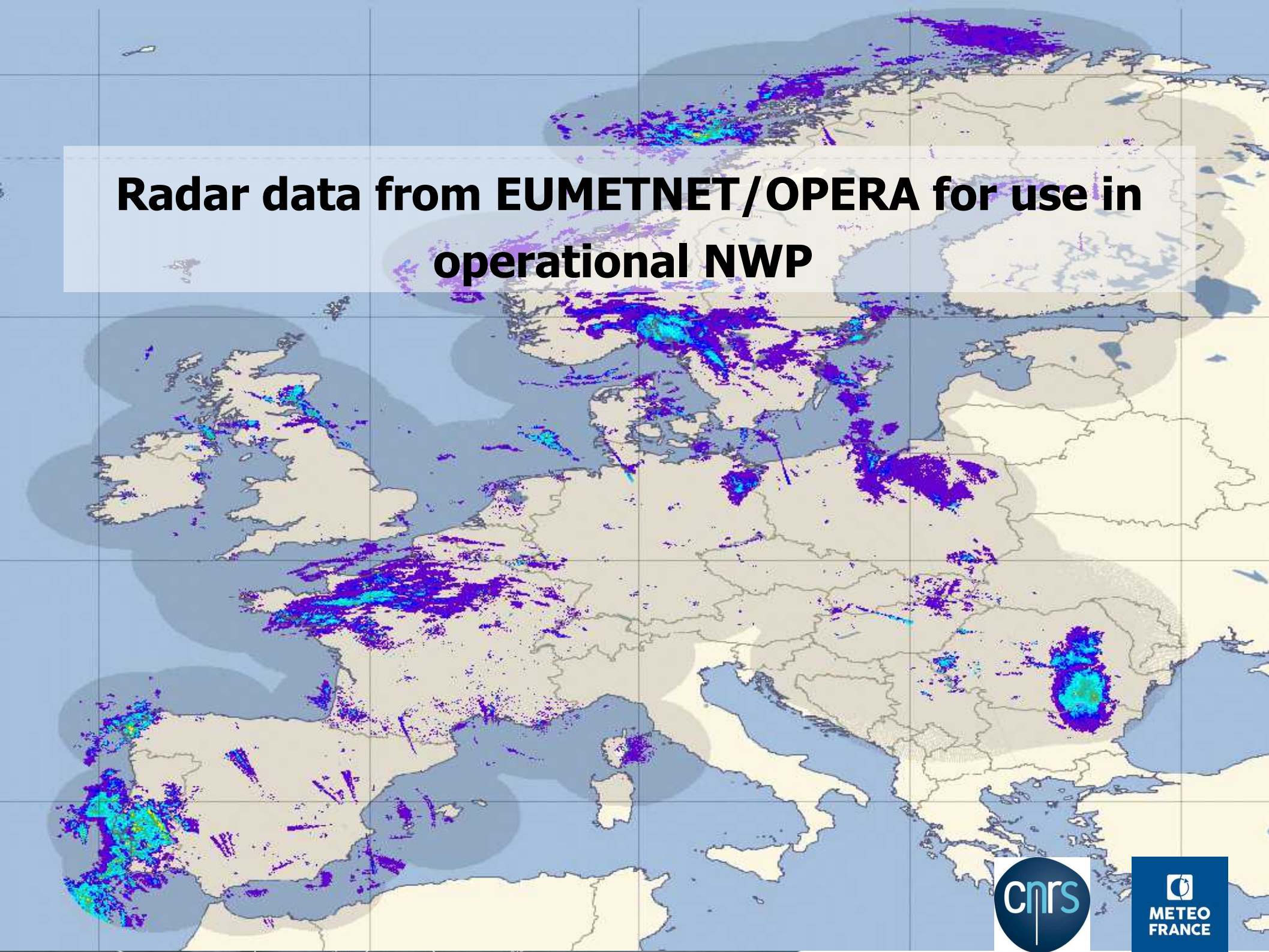
- Scheduled from autumn 2017 to mid 2018
- Migration to VORTEX (Python toolbox) for ARPEGE 4DVar, EDA and AROME 3DVar
- Migration to GRIB2 format for post-processing (lat/lon) files and using GRIB2 encoding for historical files (model geometry) based on IFS official GRIB_API library
- New horizontal resolutions for global systems (deterministic, EDA, EPS)
  - ARPEGE: ~5km over France (T_l1598c2.4L105 or T_l1798c2.2L105)
  - 4DVAR: 2 minimisations in T_l224c1L105 and T_l499c1L105
  - EPS: 35 members (unchanged) at ~7.5km over France (~T_l1198c2.2L90) and four times per day
  - EDA: 50 members in T_l499c1L105
- Modifications in the physics: tunings in PCMT convection scheme, inclusion of prognostic graupel in Arpege's microphysics, revision of surface evaporation over sea, 1D version of GELATO sea ice scheme, Flake lake model, etc.
- European radar data (AROME), Humidity observations from aircrafts, variational bias correction for aircraft data, observation correlation between infra-red channels, 2D obs operator for GPS RO data, etc.

ARPEGE new resolution

- New horizontal resolutions for ARPEGE (about 5km over Western Europe), as well as global EDA and EPS systems

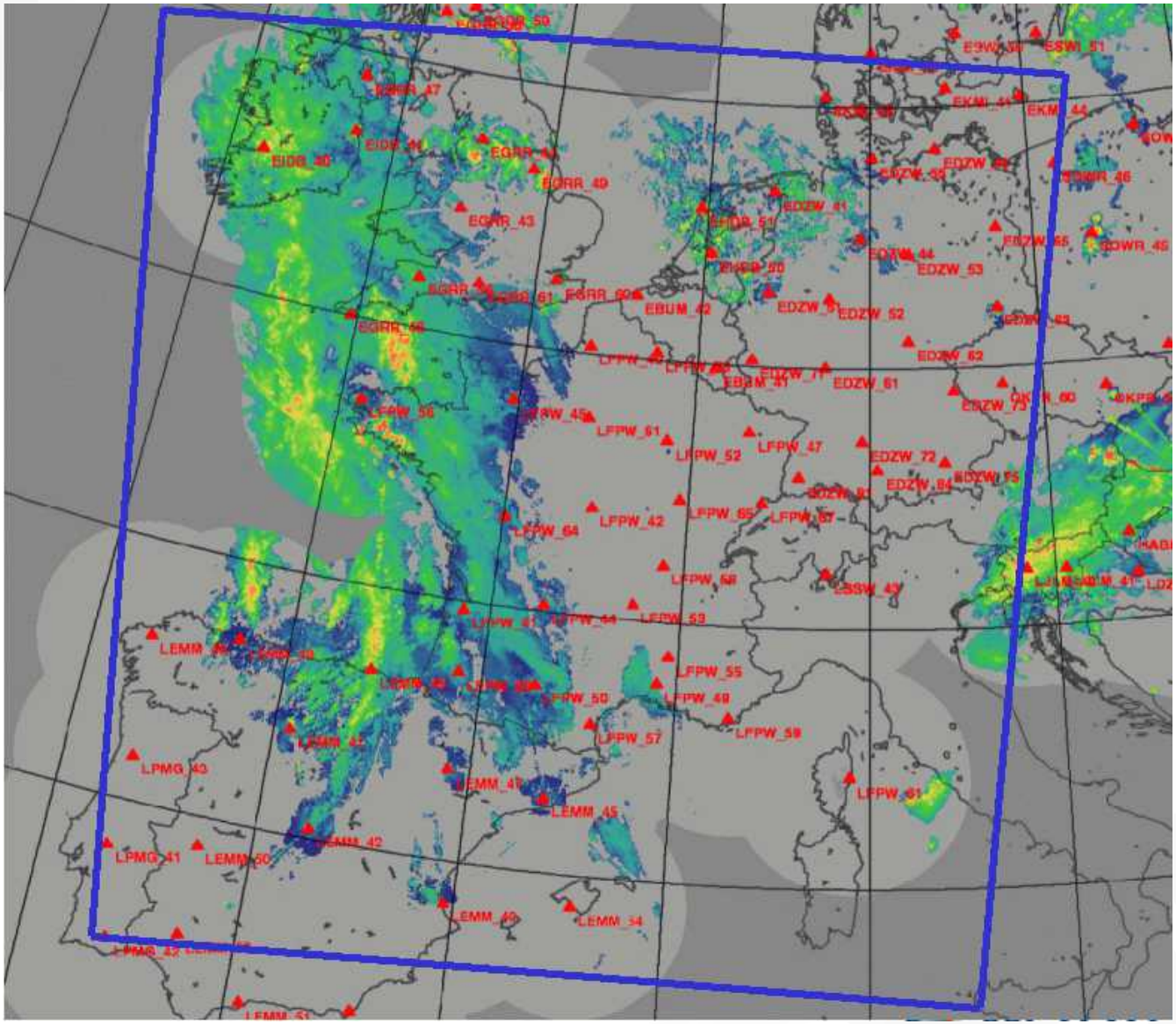


Radar data from EUMETNET/OPERA for use in operational NWP



EUMETNET/OPERA: implementation of operational monitoring o 34 radars is currently underway in AROME

- CONRAD software is no longer used
- Direct conversion and treatment of Odyssey HDF to ODB (AROME) in BATOR (34 or 50 partially included in the AROME domain)
- Feedback to Odyssey: changes in attributes coding (and no need to get back to each NMS)
- Feedback to OPERA and NMS: changes in ODIM 2.2 standard are required (and accepted), as well as for NMS, compliance with ODIM standard and required additional information is desirable in non-mandatory attributes



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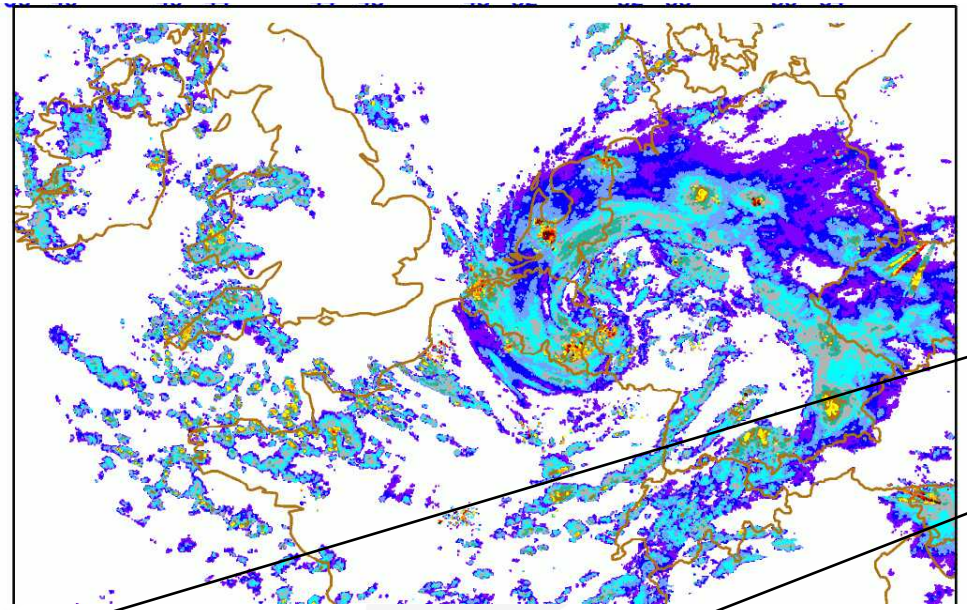
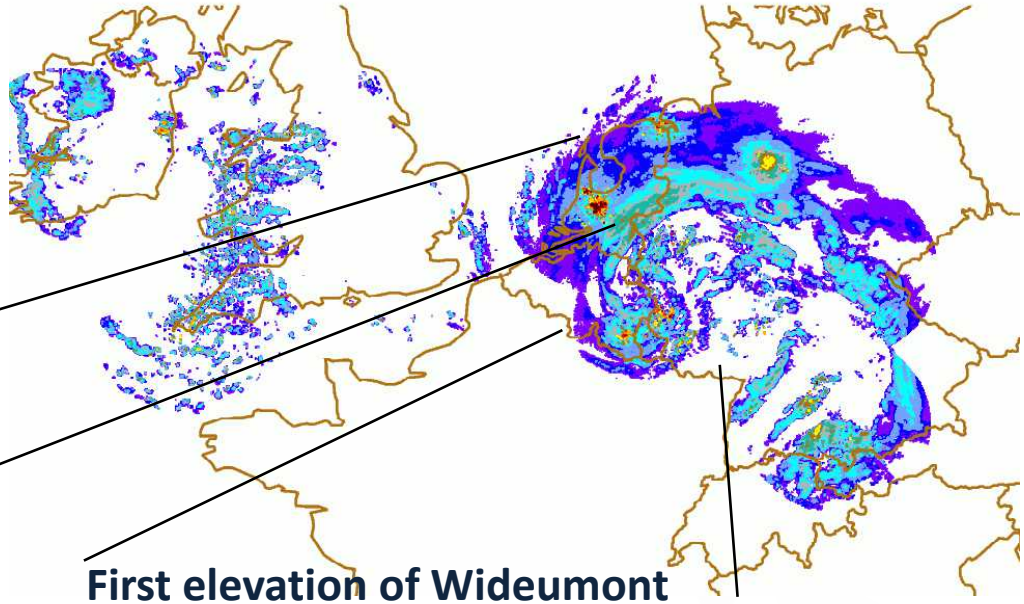
Example

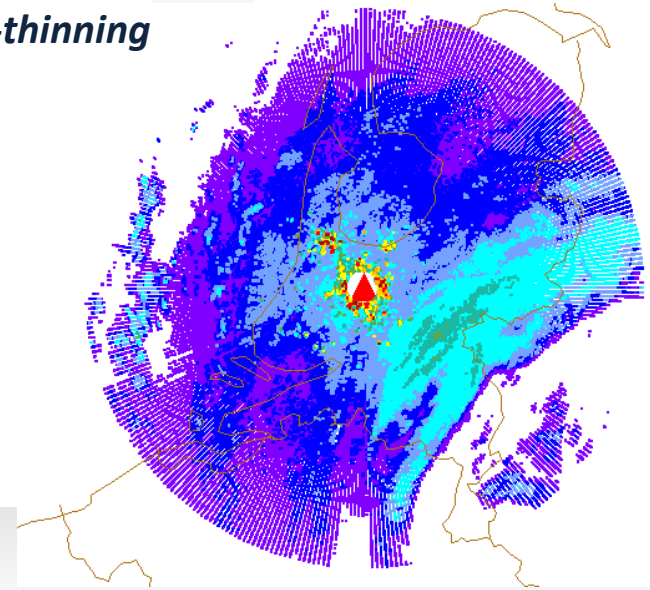
Composite ODC - 201701130000

Radar data from ODB (in AROME screening): Germany, United Kingdom, Ireland, Netherlands, and Belgium

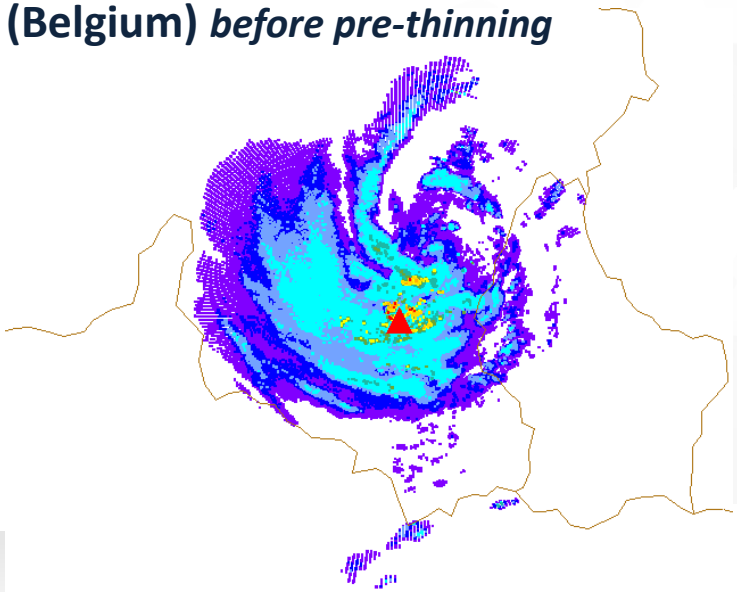




First elevation of De Bilt (Netherlands) ***before pre-thinning***



First elevation of Wideumont (Belgium) ***before pre-thinning***



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Outlook for global and/or LAM system: longer term (2017 and beyond)

- Physics : new surface schemes in SURFEX, 2 moments microphysics scheme “LIMA”, coupling with ocean and wave models, etc.
- AROME DA : EDA tested (25 members, 3.8km resolution), tested grid point Sigma_b’s, test EDA-derived B matrix of the day => fairly neutral results so far
- DA : EnVar data assimilation, with major contributions to OOPS, 4D-EnVar including an advection of localization operator, LAM prototypes developed in pace with global geometry versions
- Observations: improved assimilation of aircraft data, satellite radiances (all-sky), add Lidar winds, European radar data (OPERA)
- Expect a long lasting effort of recoding the NWP system (OOPS, COPE, ESCAPE aspects) => likely to continue to experience fairly complex common code udpates (phasing)

Nysse loppu

kiitos huomios'tanne !

c'est la fin de mon exposé

merci de votre attention